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ILLUSTRATED CATALOGUE

OF

ENGINEERING, SURVEYING
AND SCIENTIFIC

INSTRUMENTS

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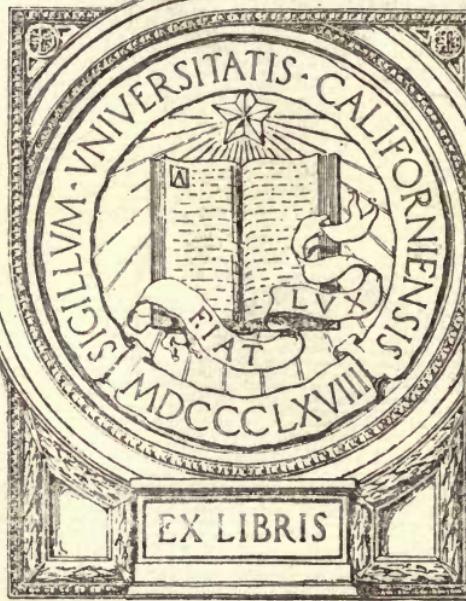
MAHN & CO.,

212 Locust Street, ST. LOUIS, MO.

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IN MEMORIAM

George Davidson 1825-1911



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In memoriam
George Davidson
1825 - 1911.

INTRODUCTION.

HAVING received many applications for Catalogues and Cuts of our Instruments, we have issued this pamphlet, pending the preparation of a more complete Catalogue.

We must say, however, that with our superior facilities, consisting of the latest and most improved machinery and tools, with the advantages of steam power, large practical and technical experience, we are enabled to compete with the best makers in quality of work as well as in prices.

To our patrons who have favored us with their orders we give our sincerest thanks ; and to our patrons, present and future, we give our word never to cease to have every possible care taken in order not to allow any instrument to leave our Factory unless we can guarantee its perfection in every particular ; and we say with some complacence that our Factory has the means to compete with makers of worldwide fame.

We are very confident that hereafter Western Engineers, Colleges, and other Educational Institutions need not go further for their instruments ; for in prices, as well as in quality, we are enabled to compete with the oldest and best-known factories in the eastern market.

We do not claim to make a very cheap instrument ; it is a fact well known to us that there are in the market instruments made only to sell, and, as to precision, have nothing but the name. These instruments are sold at prices low enough, but there is not a surveyor or engineer who does not know how many are the inconveniences, damages, and losses of time which are invariably the result of their faulty construction.

Our experience and pride forbid us to enter into competition with these, but if our prices are compared with the lists of the best makers, a good saving is apparent; and as for quality, in order to justify our claim, we do not hesitate to send our responsible patrons the instruments for inspection, trial, or comparison, in order to enable them to form their own judgment.

The suggestions of our patrons will always be cheerfully accepted as the result of an experience, which, to the constructor, sometimes may pass unobserved. One of these suggestions, after careful consideration, has led us to construct a middle-weight (about 7 pounds) transit, for mining, mountain and prospecting work, which we really believe is far superior to anything made for the same purpose to-day. All suggestions of the experienced engineer, with the careful consideration of the constructor, cannot fail to give good results, and we are always sincerely pleased to accept the judgment of those whose experience qualifies them to give wise counsel. Besides our transit-theodolites, transits, levels, etc., we make to order every variety of scientific as well as geodetic instruments, as will be seen further on in this pamphlet, at prices as low as consistent with the quality of our work.

REPAIR OF INSTRUMENTS.

We undertake the repairing of instruments of other makers as well as our own; except for instruments of our own and other first-class makes, we hold ourselves responsible for our work only, as there are many inferior instruments which cannot be made perfect, and the firm that repairs them is oftentimes censured for faults original with the constructor. To these, however, we will guarantee the best that can possibly be done.

Our patrons will please specify which parts they wish to have repaired; for it is customary in our shop, whenever there are no specified orders, to make all the repairs necessary to put the instrument in good working order.

ASTRONOMICAL INSTRUMENTS.

As is well known, these instruments are made to order only, each customer having ideas of his own, to which the constructor must adhere, to give satisfaction. For this reason, it is very difficult to give correct descriptions of these instruments and their prices. In this pamphlet we have omitted descriptions and cuts, reserving them for our future larger and more complete Catalogue. We only wish to make it known that we have means and machinery powerful enough to construct Astronomical Instruments of every size now used, and estimates for such will be cheerfully given.

MAHN & CO.



REFERENCE:

WE refer, by permission, to

PROF. J. B. JOHNSON,

Washington University,

St. Louis, Mo.,

AUTHOR OF THEORY AND PRACTICE OF SURVEYING,
who has kindly consented to reply to any inquiries con-
cerning the character of our work.



NOTICE.

IT is not our aim to take up space in this pamphlet to describe the various adjustments of instruments, for every Engineer and Surveyor can find these in all standard works on surveying, notably in **THEORY AND PRACTICE OF SURVEYING**, by Prof. J. B. Johnson. We limit ourselves, therefore, to a few hints on keeping instruments in good order, for the benefit of young Engineers, those more experienced not needing such directions.

CARE OF INSTRUMENTS.

1. In using your instrument in the field, be sure that the legs of its tripod are firm; not too loose and not too tight; this may easily be determined by raising one leg at a time to a horizontal position, and then letting it fall; if it falls abruptly, it is too loose; and if it does not fall, it is too tight; to be right it must descend slowly and easily to the ground. Do not use the instrument before ascertaining that it is set firmly.
2. Do not play with the needle, especially with iron or steel, and always screw it well up against the compass glass when not in use. In reading the needle, do not use magnifying glasses mounted in hard rubber frames.
3. If any unusual resistance is felt in the centers or object slide of Telescope, take them out and endeavor to smooth the roughened part with a piece of smooth hardened steel, like the back of a pocket-knife, etc.; in taking the centers apart, be sure to remove all the springs from spring boxes opposing tangent screws, thus leaving them free.

4. If any of the screws exposed to dust work hard, clean them well with a stiff tooth brush.

5. Do not grease any of the parts exposed to dust, but keep them clean; if any lubricating, however, is found necessary on the screws, use a little oil, work the screws back and forth a few times and then clean them. Be very careful in oiling all the parts, and more particularly the centers, not to apply the new oil before having entirely cleansed the parts of all old oil and dust. This can be done by wetting pieces of muslin with benzine, or new oil, and using until they remain clean after rubbing well all parts. For lubricating we would prefer rendered marrow, because it does not gum, but in our latitude fine watch oil is found preferable, as it does not freeze.

6. Proceed in the same manner if the resistance is found to be on the Telescope axis or clamp, and always be sure to remove spring from spring box before trying to take it apart.

7. If the glasses of Telescopes are dull and filmy, take them out and clean them with a piece of fine chamois skin or fine muslin, wetted with alcohol (spirits of wine); dry them with a piece of fine, clean muslin or linen, and brush them with a fine, clean camel's hair brush, to remove any possible dust left by the muslin, and then replace them in proper position. The object glass should not be cleaned oftener than necessary, as, in removing and replacing it, its adjustments are likely to be disturbed. It is oftentimes sufficient to clean the front glass and the glass nearest the eye in the ocular or eye piece without removing. The ocular is, however, not so susceptible to disarrangement, and can be taken out and replaced as often as desirable. To do this in our instruments, it is only necessary to loosen the top screw at the end of the main tube, directly over the ocular. To clean

the glasses with a silk handkerchief is not only undesirable, but objectionable.

8. To clean graduations on solid silver, should they happen to oxidize after using instruments in sewers or places where they are exposed to the action of acids or gases, rub them gently with a piece of chamois skin or linen wetted with fine oil, until clean, taking great care of the edges of the graduations, in order not to spoil their fineness. This is, however, a very critical operation that should never be resorted to except when absolutely necessary, and then, if practicable, by a maker only.

All the above and a few other minor inconveniences may be remedied by the Engineer or Surveyor. Should anything else happen, a reputable maker should be resorted to.

After an instrument has had a fall, if any of its parts are found stiff, and do not yield to the touch of the hand as easily as before, it should not by any means be forced, but sent as it is to a maker. If any parts, centers, plates, or axes are sprung or bent by the fall, if forced, they may press against the graduations hard enough to render them completely useless, while, if left unused, they may be repaired at a very small expense.

Too much care cannot be taken or recommended in this particular.

GRADUATIONS.

The graduations, together with the telescope, have been justly termed the soul and brain of an instrument.

We guarantee these to be accurate, the severest test in the field having thus far failed to find any appreciable errors. The lines are perfectly straight, black, and uniform. All of our transits have two double verniers, as

seen in the cuts. They were often placed at an angle of 30 degrees to enable the engineer to read a vernier without changing the position after sighting. Covers of fine glass protect the verniers from exposure, and two plates of ground glass cast a very clear light, which enables the readings to be made with great ease.

The graduations are either on brass silver-washed, or on solid silver for the finest instruments.

TELESCOPE.

This most important part of a good instrument we guarantee to be the best made. We really claim to make the best Telescopes, and without going into small details of construction (found in every Engineer's handbook), we leave it to our patrons themselves to judge, after comparing ours with any of the best makers they may wish.

Comparisons are said to be odious, but it cannot be denied that they are sometimes instructive.

Our experience also has taught us a judicious method of construction, by which we are enabled to guarantee their correctness at all distances. All Telescopes have a protection over-slide, although in some it is not shown in the cuts.

SPIRIT LEVELS.

Our spirit levels are carefully ground and thoroughly tested in our shop.

The finest levels for astronomical instruments we provide with an air chamber for the regulation of the length of the bulb, but this is not necessary in surveying instruments generally. We grind our glasses according to the grade of the instrument, and we guarantee all of them to have a uniform curvature.

ILLUMINATING OF CROSS WIRES.

When desired we make at a small extra expense an arrangement to illuminate cross wires. The system is about the same as used in astronomical instruments, and very easy to operate.

SHIFTING CENTERS.

All of our Transits and Theodolites have the shifting centers, and at a small extra expense we can attach to them a quick-leveling attachment; this can also be attached to all our Levels.

CLOTH FINISH.

We are prepared, when desired, to give to our instruments what is termed a cloth-finish. We, however, frankly say that we do not admire this finish, as it looks decidedly ugly as soon as the newness is gone. Furthermore, it has no advantages over any other finish, as we know by long experience. We like our finish much better, as being finer, prettier, and lasting longer.

GENERAL CONSTRUCTION.

In conclusion, we must say that the general construction of our instruments is the result of many years of experience and study.

In our experience in Europe and America, we had the opportunity to study all the best makers, and as a result we adopted a system that we can thoroughly recommend. We allow superiority to no one. The metal adopted is very

hard, unyielding brass and bell metal. We gave aluminum and the kindred metals due attention, and, except for a few of the minor parts, we do not recommend it. All of our transits have long, very hard, unyielding centers, perfectly concentric; a very hard telescope axis, and all other parts harder than are commonly used.

Our Levels have either very hard, bell-metal or steel centers, and bell-metal collars in wyes.

SCIENTIFIC INSTRUMENTS.

Persons who consult this pamphlet will see cuts of some scientific instruments which we have manufactured from the designs of the inventors, among whom may be mentioned Professor J. B. Johnson and Mr. B. H. Colby, of this city.

Prof. J. B. Johnson does not need to be introduced, as we believe there is not another person more or better known to the engineering profession.

Mr. B. H. Colby is the chief Topographical Engineer of St. Louis, and is well known as an expert topographical surveyor.

We are the sole manufacturers of these instruments.

GENERAL REMARKS.

Our firm being comparatively new, our cuts are somewhat limited. We manufacture, however, many sizes of instruments which differ from the cuts in size only; we did not deem it necessary to have cuts of all sizes made for this pamphlet; we reserve these for our future larger Catalogues, and for the present content ourselves with but few descriptions.

We have, for instance, but one cut of a Transit-Theodolite, while we manufacture several. One of a Mountain Transit, while we manufacture two, and almost all of our Engineers' Transits we manufacture in two sizes. In Transits the difference is mostly in size, while in Theodolites it is in style also.

We wish also to make it known that, while we did not deem it necessary to have wood-cuts made for illustration (they all being well known and nothing new), we furnish the profession and all educational institutions with every style of Rods, Poles, Chains, Tapes—in fact, the entire outfit—in any quantity at lowest prices consistent with the quality of the goods.

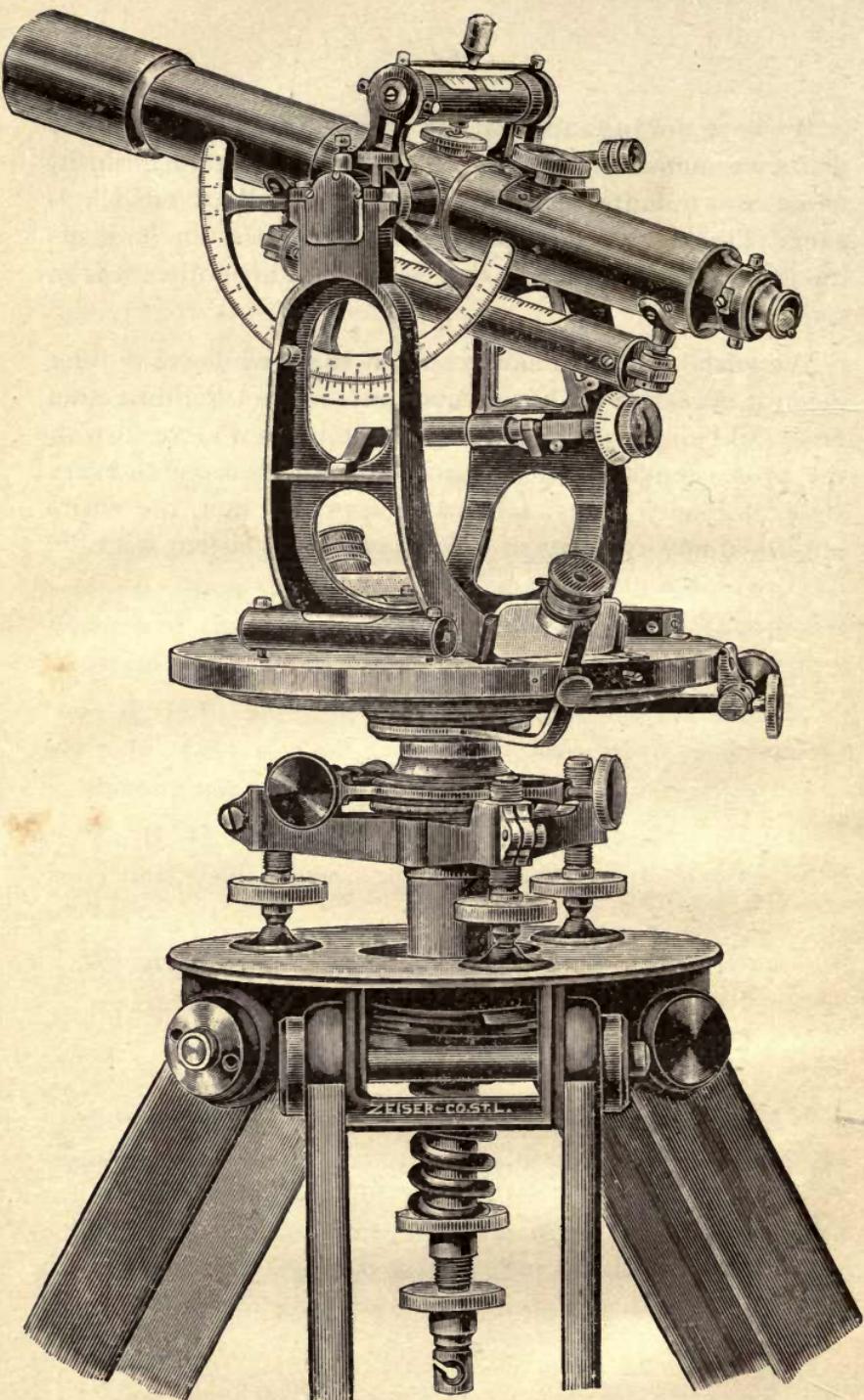


Fig. No. I.—TRANSIT-THEODOLITE.

TRANSIT-THEODOLITE.

After many inquiries for instruments capable of doing, in the highest degree, rapid and accurate work, and combining at the same time lightness and portability, and after seeing the success of instruments of this kind, introduced into this country by one or two of the best makers, we decided to design one, which, we feel, is an improvement.

We manufacture this instrument in several sizes—from five to eight inches diameter of horizontal circle—but we mostly recommend our seven-inch as being the most convenient for lightness and portability, and experience has shown it to be large enough to admit graduations reading to $10''$, by verniers.

When the plates are too small for a given kind of graduation, it makes the same difficult to read, as two or more lines over the vernier appear to correspond with the opposing line on the plate.

This instrument is provided with either three or four leveling screws, as may be desired; the verniers can be placed either at right angles with the line of sight, or at an angle of 30 degrees, as in cuts; if so desired they can easily be placed directly in the line of sight.

Complete Transit-Theodolite with horizontal circle, $6\frac{1}{4}$ inches in diameter; two double verniers reading $20''$; vertical arc or circle 5 inches in diameter; double vernier reading to minutes; two reading glasses attached to instrument to read horizontal limb; and one attached to standards to read vertical limb, verniers on horizontal plate well protected by finest plate glass; ground glass vernier shades; 11 to 12-inch Telescope (inverting or erect); $1\frac{3}{8}$ -inch aperture, clear and powerful; object slide well protected; reversible

clamp to Telescope; compensating tangent screws; gradi-enter screw.

Weight of instrument complete, about 13 lbs.; weight of tripod, about 7 lbs.

Mahogany box containing sun shade, a wrench, a screw-driver, a plumb bob, and several adjusting pins.

Price, complete as above \$300 00

With horizontal limb, 7 inches in diameter, and verniers reading 10", otherwise same as above.

Price, complete \$320 00

NOTE.—It is understood that instruments of this class have all the graduations on solid silver. The above-quoted prices are for instruments with three leveling screws and fixed stadia wires.

EXTRAS TO TRANSIT-THEODOLITES.

Oblong compass	\$ 17 50
Adjustable stadia wires	7 00
Five-inch vertical circle, with two double verniers, reading 30"; attached reading glasses; graduation well protected	17 50
Level attached to arm, carrying the two double verniers of vertical circle	15 00
Striding level bearing on axis	17 50
* Six-inch striding level over Telescope, instead of usual fixed level	25 00

*The Striding Level over Telescope can be attached either when the Telescope is normal or reversed.

ENGINEERS' TRANSIT, NO. 1 A.

Transit No. 1 A is shown in cut No. 2 with the standards cloth finished; but, as we explained before, we do not admire this finish, and do not recommend it.

This instrument has been designed to supply the want of Engineers wishing a well-made, moderate-priced instrument of good design.

It is a light, very strong, and well-made instrument, with all the latest improvements.

Horizontal circle, $6\frac{1}{4}$ inches in diameter; two double verniers reading to $30''$; verniers protected by glass plates; shades over verniers; graduations on brass, silvered; radial clamps with compensating tangents; adjustment for the vertical plane of Telescope; the Telescope we guarantee to be of the best, 11 inches long, clear and powerful; object glass with $1\frac{1}{4}$ -inch clear aperture; objects seen erect.

The split-leg tripod is considered very strong. Its legs are of the best ash, and the tripod-head a strong casting in one piece.

Mahogany box, containing sun shade, plumb bob, etc.

Price, plain	\$165 00
With clamp and level to Telescope	175 00
Complete with vertical arc or circle reading to minutes	185 00

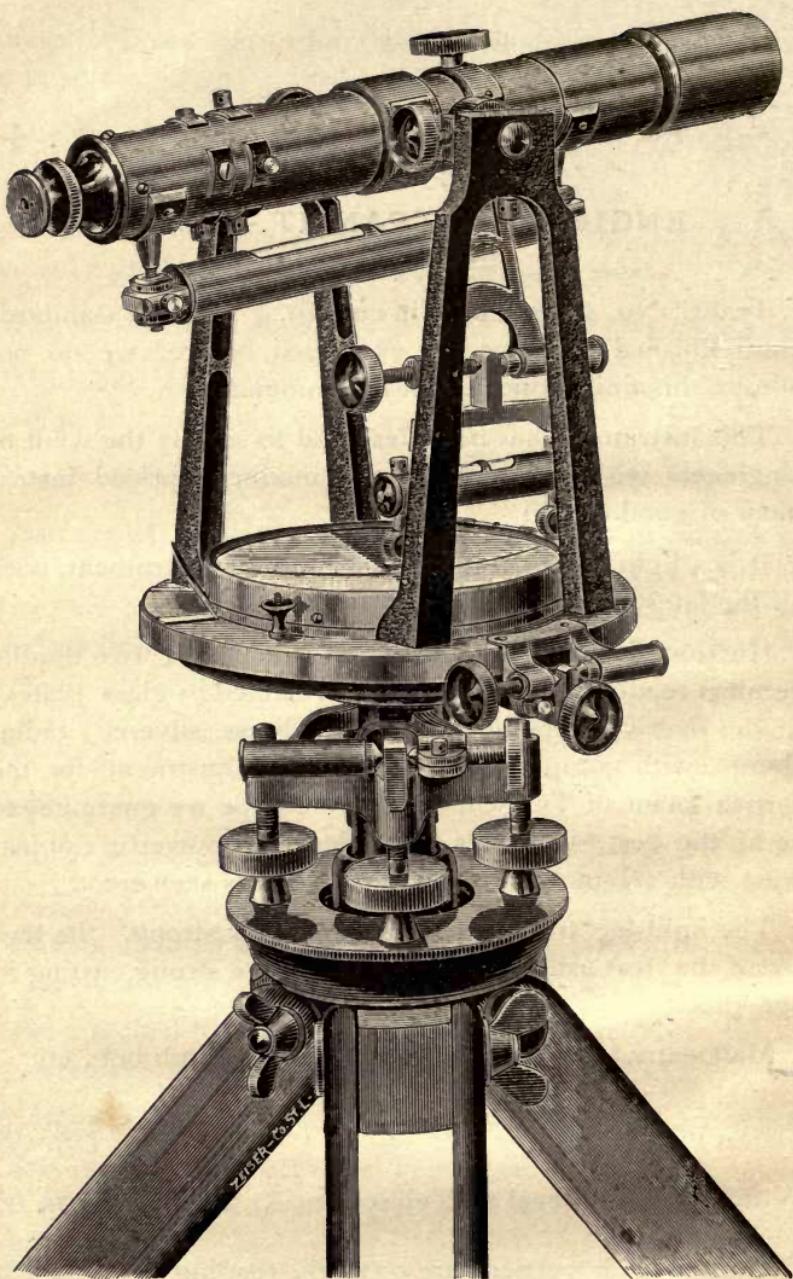


Fig. No. 2.—ENGINEERS' TRANSIT No. 1 a.

EXTRAS TO ENGINEERS' TRANSIT NO. 1 A.

Stadia wires, fixed	\$ 3 00
Stadia wires, adjustable	10 00

NOTE.—To those preferring it, we are prepared to give this instrument a black or green finish at five dollars less than its regular price. It must not be inferred by this that these are not good and handsome finishes; the contrary is the truth, for both of them are very pleasing to the eye; they are finely lacquered and wear considerably longer than all other finishes except yellow, and are very much liked by all who have seen them. Furthermore the green finish is very pleasing, and not at all troublesome in the sunlight.

We make these finishes cheaper simply because, not requiring the straight-grain finish surface, it requires on our part less labor, and we decided to let our patrons have the benefit.

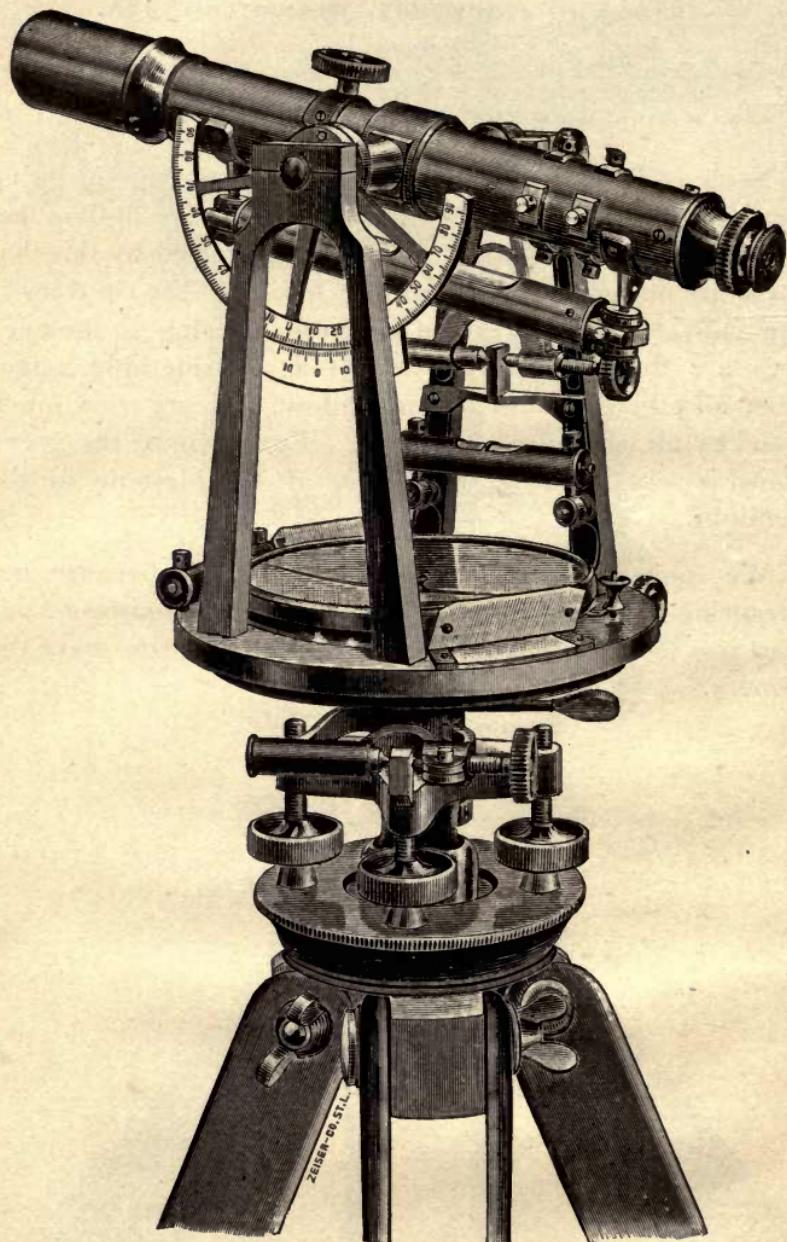


Fig. No. 3.—ENGINEERS' TRANSIT No. 1 b.

ENGINEERS' TRANSIT NO. 1 B.

Fig. No. 3 is a cut of a complete Engineers' Transit in every way similar to No. 1 A. It differs slightly from cut. We make it now with base of standards reinforced.

Its dimensions are exactly as in No. 1 A, viz.: 6½-inch horizontal circle; two double verniers reading to 30"; graduations on brass, silvered; shades over verniers; magnetic needle, 4½ inches long; radial clamps and compensating tangents; adjustment for the vertical plane of telescope; telescope 11 inches long, clear and powerful; 1¼-inch clear aperture; objects seen erect; split-leg tripod.

Mahogany box containing sun shade, wrench, plumb bob, reading glass, and two adjusting pins.

Complete with vertical arc or circle five inches in diameter, and double vernier reading to single minutes.

EXTRAS.

Fixed stadia wires \$ 3 00
Adjustable stadia wires. 10 00

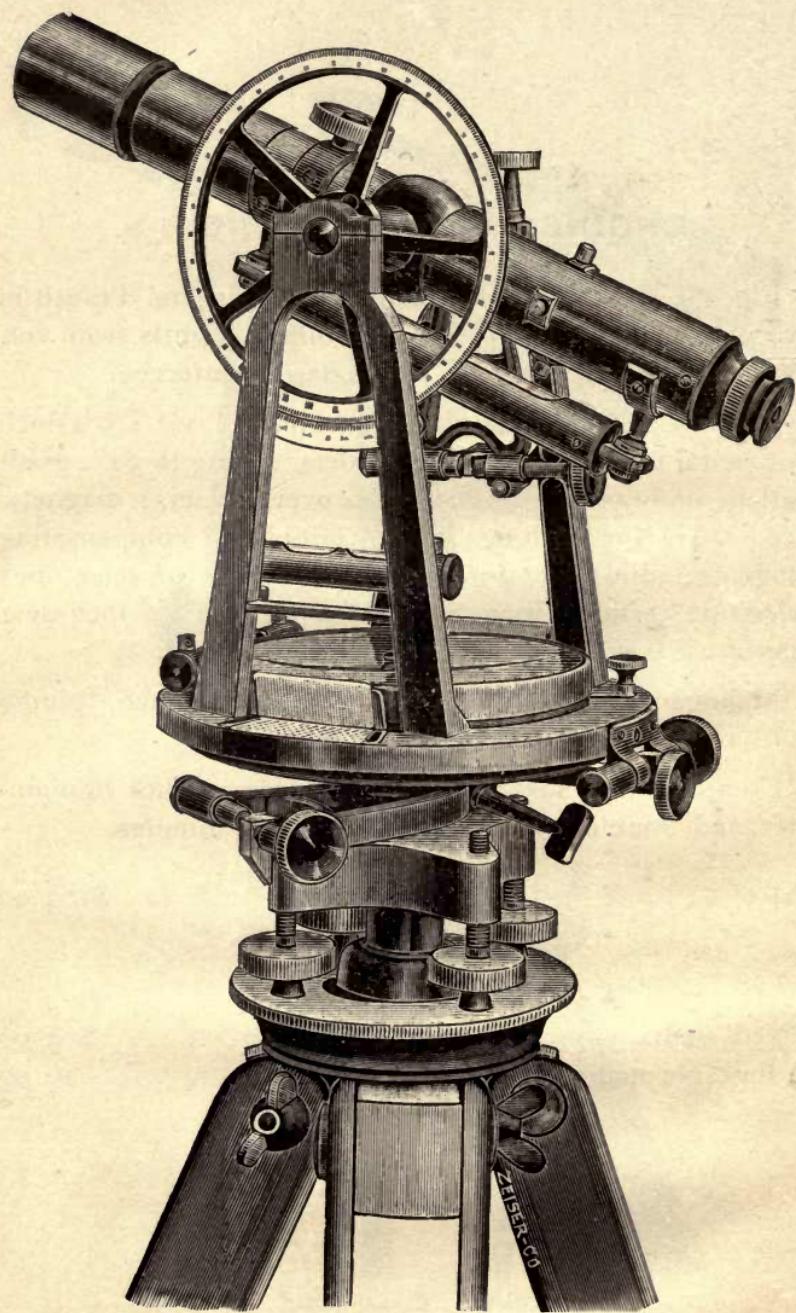


Fig. No. 4.—ENGINEERS' TRANSIT No. 1 c.

ENGINEERS' TRANSIT NO. 1 c.

Fig. No. 4 is a cut of Transit No. 1 c, our latest model. It is really a magnificent instrument, capable of doing the most accurate work. In cut it is shown with verniers at 90° from the line of sight, or between the standards. When desired, however, we place them at an angle of 30° , or directly in the line of sight.

The position at 90° , however, has this advantage, that it admits of a longer level on the plate, which is desirable.

It has a horizontal limb $6\frac{1}{4}$ inches in diameter; two double verniers reading at $30''$; vertical limb, five inches in diameter, with a double vernier reading to single minutes; all graduations on solid silver; magnetic needle, $5\frac{1}{2}$ inches long; radial clamps with compensating tangent screws; ground glass shades over verniers; $5\frac{1}{2}$ -inch sensitive spirit level to Telescope.

The Telescope is from 11 to 12 inches long, very clear and powerful; clear aperture of object glass, from $1\frac{1}{4}$ to $1\frac{3}{8}$ inches; improved eye-piece; fixed stadia wires.

We must strongly recommend this instrument to those who do not wish a Transit-Theodolite for the most accurate work.

Price, complete, as above	\$220 00
Without vertical arc or circle, but with level and clamp to Telescope	205 00
Plain	190 00

EXTRAS TO TRANSIT NO. I C.

Gradienter screw	\$ 5 00
Variation plate	10 00
Adjustable stadia wires	7 00
Fixed reading glasses for reading horizontal limb	10 00
Fixed reading glass for reading vertical limb . .	5 00
Two reading glasses to vertical limb	8 00
Two double verniers to vertical limb, reading to 30'', graduations well protected.	17 50
Striding level	17 50
Striding level fixed to arm carrying the two ver- niers of vertical limb	15 00
Arrangement for offsetting	4 00
Three leveling screws instead of four	7 50

NOTE.—We also make this instrument with a 6 or 7-inch striding level to Telescope instead of the usual fixed level. This can be attached to Telescope whether the latter is in a normal position or reversed. Price, extra, \$25 00. When desired, we can provide this instrument with a solar attachment.

ENGINEERS' TRANSIT NO. 2.

We did not deem it necessary to have a cut made for this instrument, it being essentially the same as our No. 1 c, with the exception of size and weight.

No. 2 is a very carefully and perfectly made instrument. The Telescope is large and powerful enough to admit ordinary stadia measurements, and horizontal limb large enough to admit of the readings to single minutes with the utmost ease. It is very efficient for good railroad work, general land surveying and mining purposes. Its lightness makes it very desirable in many instances, and it is strong enough to admit of the attachment of an auxiliary side or top Telescope without undue strain.

The dimensions are: Horizontal limb, five inches, with two double verniers reading to single minutes; magnetic needle, $3\frac{1}{2}$ inches; Telescope, 9 to 10 inches; clear aperture $1\frac{1}{8}$ inch.

Weight of Instrument, about 9 lbs.; weight of tripod, 6 $\frac{1}{2}$ lbs.

Price of Instrument with graduations on solid silver, and fixed stadia wires:

Plain	\$186 00
With clamp and level to Telescope	200 00
Vertical arc or circle, 5-inch double vernier reading to minutes	215 00

EXTRAS TO TRANSIT NO. 2.

Gradienter Screw	\$ 5 00
Adjustable Stadia Wires	7 00
Variations Plate	10 00
Arrangement for offsetting	4 00

EXTRAS TO TRANSIT NO. 2, FOR MINING PURPOSES.

Striding Level	.\$17	50
Lamp with ground lens, for the illuminating of the cross wires	6	00
Lampholder attached to standards	2	50
Reflector for illuminating the cross wires	3	00
Diagonal Ocular	16	00
Prism	6	00
Detachable Side Telescope	30	00
Detachable Top Telescope	50	00
Extension Tripod	15	00
Plummet Lamp	7	50
Stadia Wires, adjustable	7	00
Gradienter Screw	5	00

This Instrument can also be provided with solar attachment.

MOUNTAIN TRANSIT.

After many inquiries and some suggestions of eminent Engineers, we decided to give a special study to this most convenient of Engineering Instruments, with the result that we decided to manufacture two sizes; one with horizontal limb, $4\frac{1}{2}$ inches in diameter, and the other 4 inches.

The former is a little heavier (7 lbs.), but its very weight gives it the advantage of being steadier in windy climates (where they are generally used), and for mining purposes, will admit of a side Telescope and all accessories as described in Transit No. 2.

The smaller has the advantage of being lighter, and consequently more portable (although still very strong). All the above extras would be a great strain upon it. They are styled No. 3 A, and No. 3 B, and are essentially similar to our No. 1 A, except in size. They are very carefully and perfectly made.

No. 3 A has a horizontal limb $4\frac{1}{2}$ inches; two double verniers reading to single minutes; ground glass shades over verniers; vertical limb 4 inches; double vernier reading to single minutes; all graduations on solid silver; magnetic needle, $3\frac{1}{4}$ inches long; Telescope, $8\frac{1}{2}$ inches long; clear and powerful erecting or inverting eye piece; $1\frac{1}{8}$ -inch clear aperture; 4-inch sensitive level to Telescope, and 2-inch level on plate; shifting center and radial clamps with compensating tangent screws; extension tripod.

Mahogany box containing all appendages, as in our larger Transits, and provided with shoulder strap.

Price, complete, as above \$200 00

Transit No. 3 A can also be provided with solar attachment.

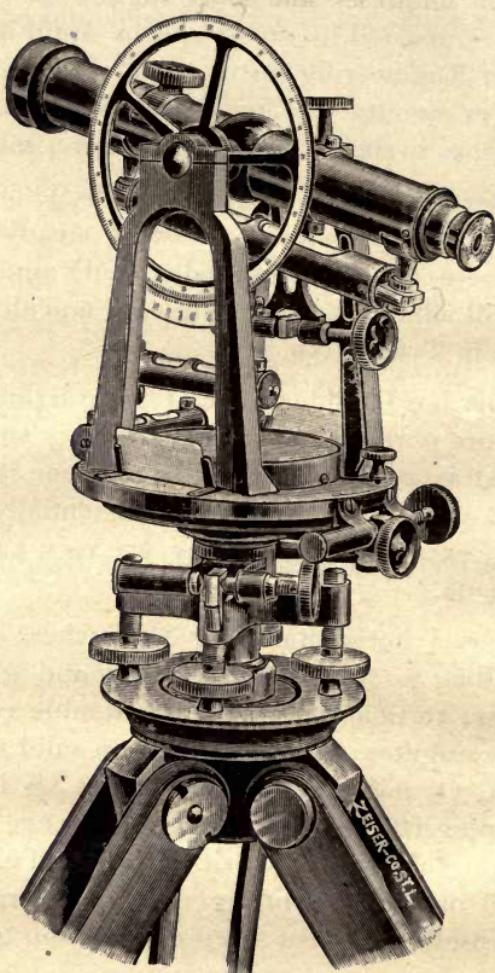


Fig. No. 5.—MOUNTAIN TRANSIT.

EXTRAS TO TRANSIT NO. 3 A.

Fixed stadia wires	\$ 3 00
Adjustable stadia wires	10 00
Prism and colored glass for solar observations .	—
Leather cover over box	5 00

EXTRAS TO TRANSIT NO. 3 A, FOR MINING PURPOSES.

Striding level	\$ 17 50
Lamp with ground lens for illuminating the cross wires	6 00
Lamp holder attached to standards	2 50
Reflector for illuminating the cross wires	3 00
Prism	6 00
Detachable side Telescope	30 00
Plummet lamp	7 50

No. 3 B has:

Horizontal limb, 4 inches; two double verniers reading to single minutes; vertical limb, 4 inches; double vernier reading to minutes; graduations on solid silver; ground glass shades over verniers; magnetic needle $2\frac{3}{4}$ inches long; Telescope 8 inches long, clear and powerful; erecting or inverting eye peice; 4-inch sensitive level; radial clamps, and compensating tangent screw; extension tripod, etc.

EXTRAS TO NO. 3 B.

Stadia wires, fixed	\$ 3 00
Stadia wires, adjustable	10 00
Leather cover over box	5 00

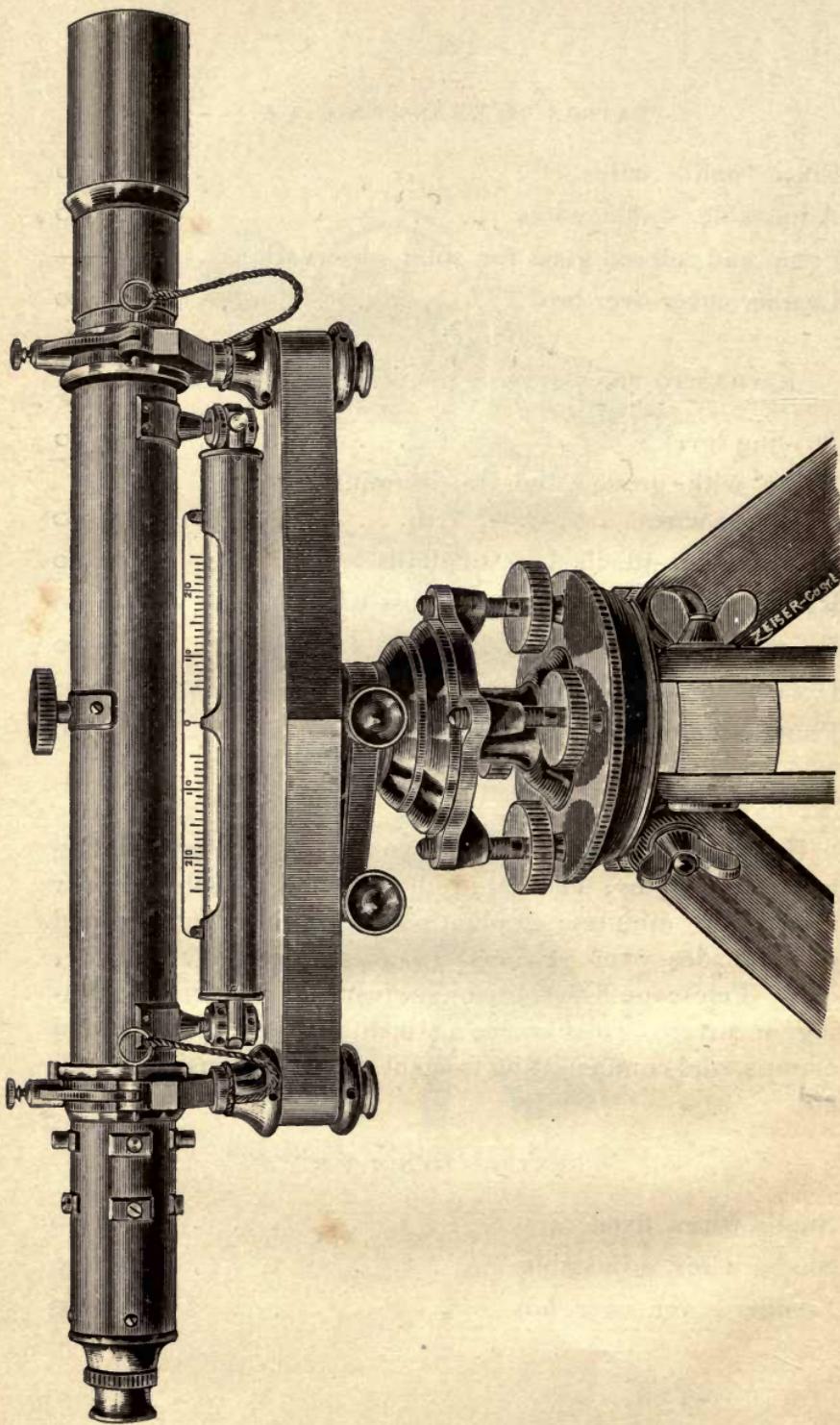


Fig. No. 6.—WYE LEVEL No. 1.

WYE LEVEL NO. 1.

This Level we consider the most improved form. The leveling plate is of the best hard metal, provided with quick-leveling movement. The bar is of hard brass, cast hollow, and provided with very strong ribs. The wyes are made of the best hard metal. We make our wyes now in our improved model, as shown in cut of Level No. 2; 8-inch sensitive spirit level; Telescope provided with stout rings of hard bell metal; and with a stop to readily set wires in a horizontal or perpendicular position; object glass $1\frac{3}{8}$ to $1\frac{1}{2}$ inches aperture, very clear and powerful, with field of view large and flat; line of collimation guaranteed true for all distances; radial clamp and compensating tangent screw; instrument packs whole.

Mahogany box containing wrench, screw-driver, two adjusting pins, and the sun shade of Telescope. Split-leg tripod.

We make this Level in three sizes, viz.: 18, 20 and 22-inch lengths of Telescope; weight of instrument, about $10\frac{1}{2}$ lbs.

	Price.
18-inch wye level, as above	\$125 00
20-inch " " "	132 50
22-inch " " "	140 00

EXTRAS TO WYE LEVEL.

Centers made of hardened steel	\$ 7 50
Fixed stadia wires	3 00
Adjustable stadia wires	10 00

NOTE.--For convenience in reading the bubble in soft ground, without changing position, we can furnish, when so desired, to our leveling instrument, a mirror with universal joint, at an extra expense of \$10.00.

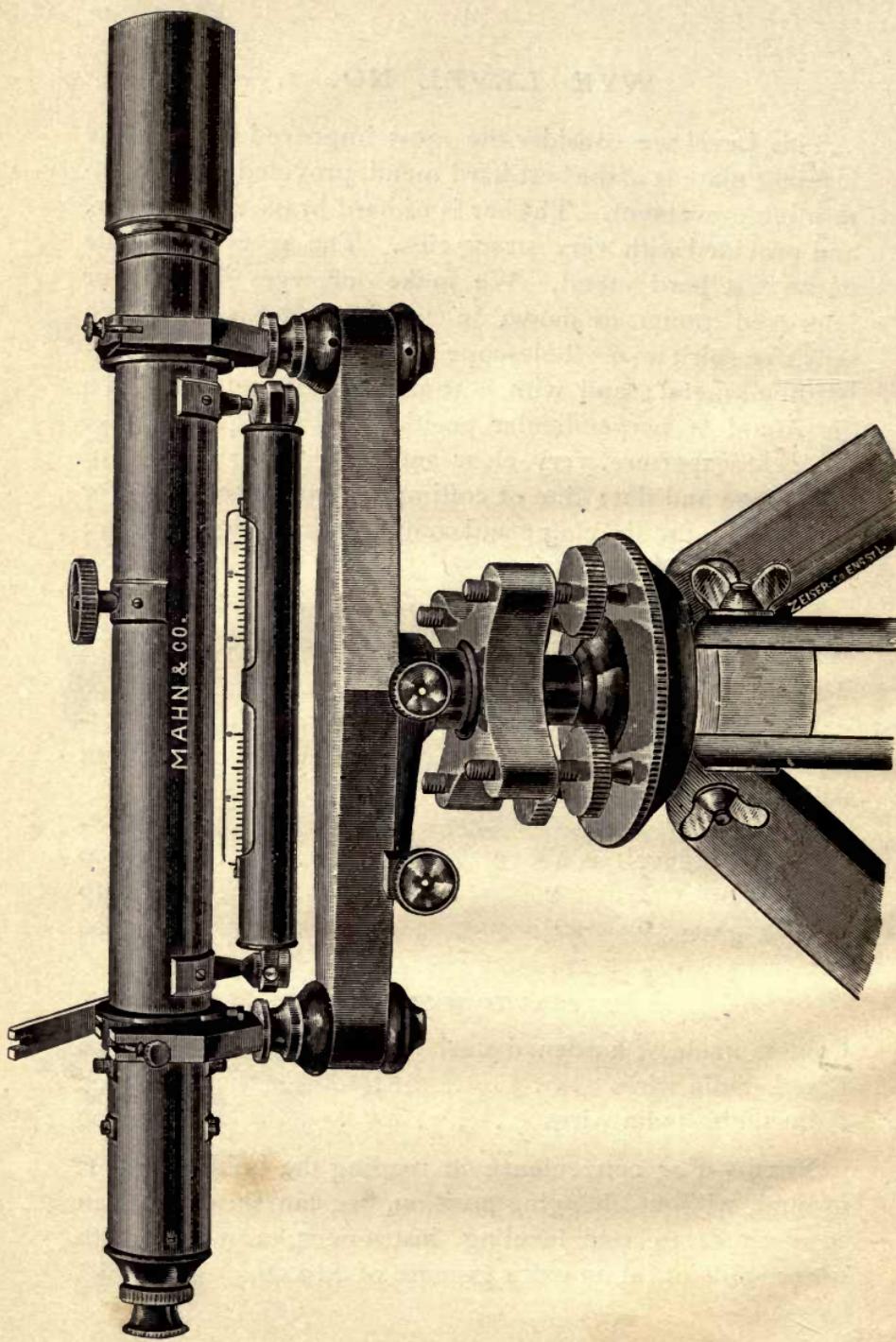


Fig. No. 7.—WYE LEVEL No. 2.

WYE LEVEL NO. 2.

Level No. 2 has the same quality and sizes as No 1, except that it is not made quick-leveling. The center plate is similar to that of our Transits; otherwise it has the same bar, and the same radial clamp. The wyes are our improved model, which will be found the strongest and most convenient made, there being no pins to get lost, and the clips cannot possibly get loose. We have now adopted this system in all of our levels.

All other dimensions are the same as in No. 1, with same fine Telescope provided with dust protection over slide. (Not shown in cut).

	Price.
18-inch	\$120 00
20-inch	127 50
22-inch	135 00

Extras same as No. 1.

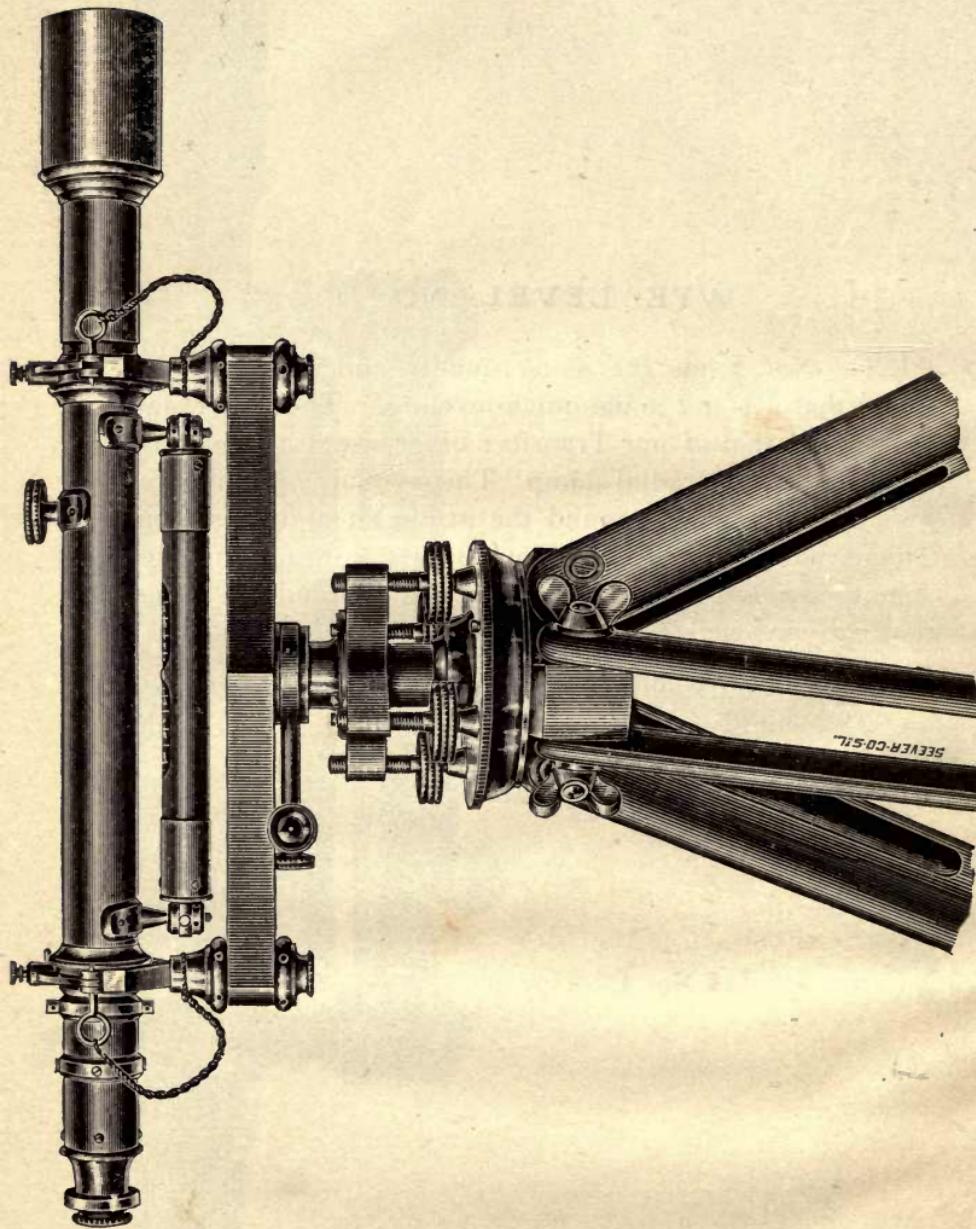


Fig. No. 8.—WYE LEVEL No. 3.

WYE LEVEL NO. 3.

This is a very light, portable level, and at the same time very strong. It has all the improvements, as radial clamp, with compensating tangent; 6½-inch fine spirit level; 16-inch powerful Telescope, with large, flat field of view; objects seen erect. The Telescope has rings of hard, bell metal; split-leg tripod. This Level is also furnished now with our improved wyes.

Price \$100 00

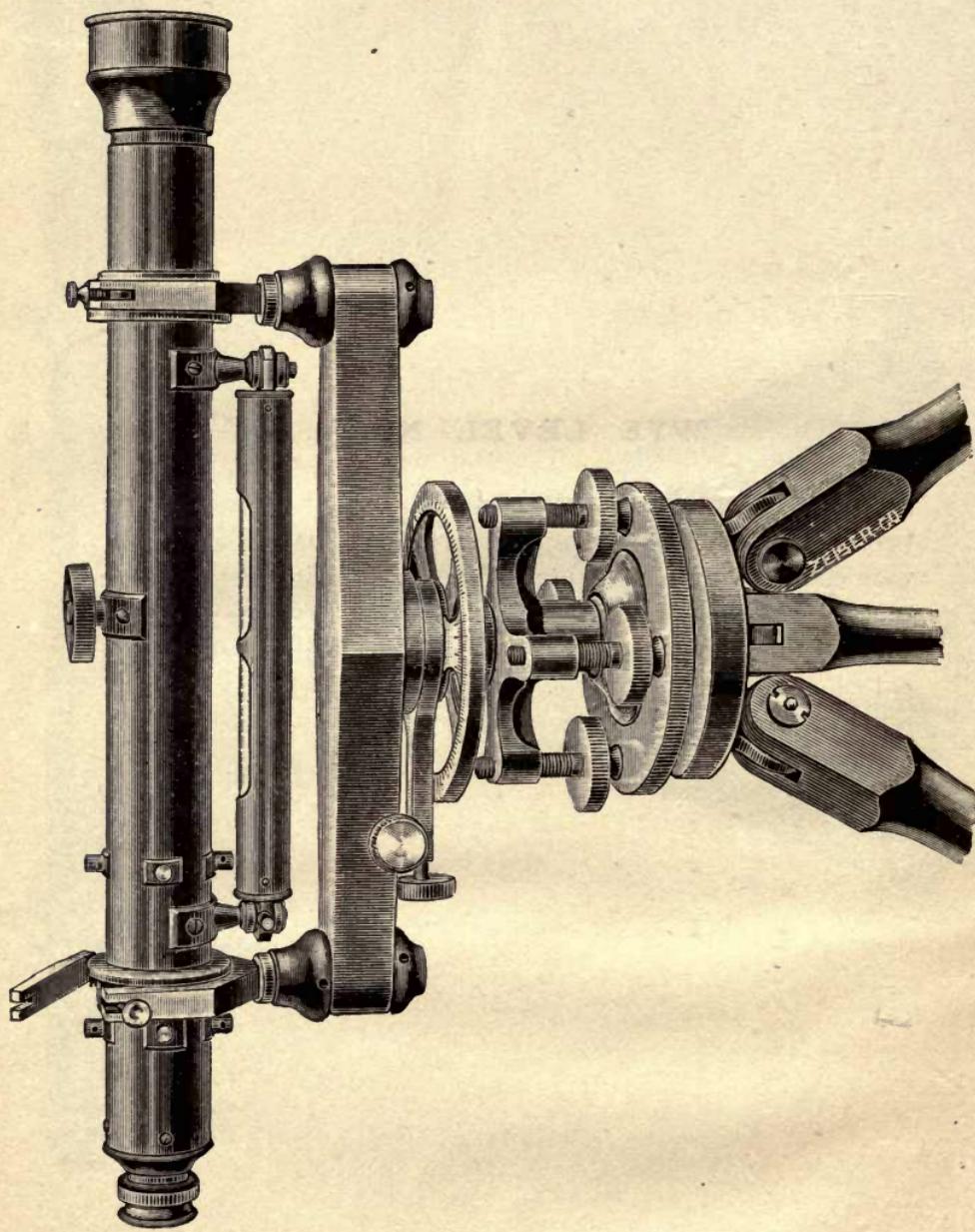


Fig. No. 9.—ARCHITECT LEVEL

IMPROVED ARCHITECT LEVEL.

This instrument was designed to supply a long-felt want. It is primarily a superior Architect Level, but able to do at the same time very accurate leveling work. It has a very strong reinforced center plate. It is provided with a 4-inch horizontal circle, graduated to degrees, figured from 0 to 90°, each way, and is read to five minutes by a vernier attached to the spindle. It is provided with radial clamp and compensating tangent screw; a 6-inch sensitive spirit level; Telescope 15 or 16 inches long, clear and powerful; object glass 1½ to 1¾-inch clear aperture; field of view large and flat; in fact, a very good, reliable instrument.

In mahogany box, price \$75 00

PRECISE LEVELING INSTRUMENT.

NOTE.—We are now designing a *Level of Precision*, a cut of which will be found in our future large Catalogue. We are enabled, however, to give here a description.

This Level will differ from our other Levels in that it is always made with three leveling screws; it has a horizontal circle from 5 to 6 inches in diameter, graduated to read to 30" and 20"; graduations on solid silver; radial clamps with compensating tangent screws; the bar is very hard and unyielding; wyes of very hard metal with agate bearings; steel center; front wye is set to the bar very firmly, with steel screws in steel bearings, and has a balancing front movement; the other wye is adjustable by a very precise micrometer screw with graduated head, which can also be used as a gradiometer; the rising and depressing of the telescope is made with the utmost exactness.

The Telescope has an aperture of 1½-inches or more: 18 inches focus; two very powerful astronomical oculars.

The spirit level is of an improved form (fixed astride), which can easily be taken off when desired, and is chambered to regulate the length of the bulb; the sensitiveness of the bulb is so that one of its divisions corresponds to from 2 to 5 seconds of arc as desired.

Further particulars will be cheerfully given to those wishing them.

PROF. JOHNSON'S EXTENSOMETER.

AN APPARATUS FOR MEASURING THE DISTORTIONS OF TEST SPECIMENS.

Fig. No. 10 is a cut of Prof. J. B. Johnson's Extensometer.

It consists of two brass collars having $2\frac{1}{2}$ -inch openings, which are held upon the specimen to be tested by three pointed steel screws, one of which has a spring bearing.

To each collar is attached a graduated circle, four inches in diameter, carrying upon its face a balanced vernier needle. The needle is rigidly attached to an axle that turns very freely, but without any lost motion, on which is arranged a perfectly true cylinder exactly one-half inch in circumference.

An elastic steel armature is rigidly attached to each collar, and has a friction bearing with spring pressure on the rolling cylinder upon the other collar. These cylinders and armatures are symmetrically mounted on the two opposite sides of the bar to be tested, so that any warping or bending of the bar under test affects the movement of the two cylinders equally, but in opposite directions, and the mean of the two readings is always free from the effects of such movements.

The circles are graduated into 500 subdivisions, and the small vernier at the end of the index needle reads to one-tenth of one of these spaces, so that the smallest reading of the instrument corresponds to one-ten-thousandth of an inch.

Readings are easily made to one-twenty-thousandth of an inch with perfect accuracy.

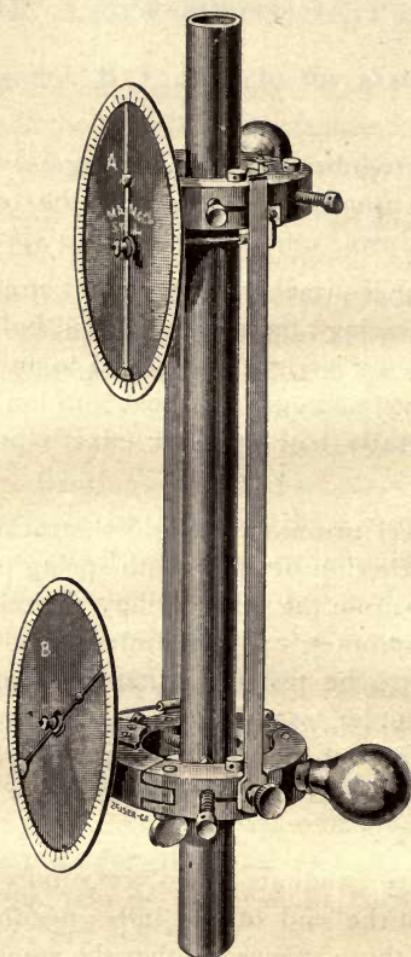


Fig. No. 10.—PROF. JOHNSON'S EXTENSOMETER.

The advantages of this apparatus are:

1. It is equally well adapted to horizontal and vertical positions of the test bar.
2. It gives the average stretch of both sides of the bar, and so eliminates all unsymmetrical distortions of the bar.
3. It is equally well adapted to tension or compression tests.
4. It is adapted to all lengths of specimen above three inches of tested section, by simply substituting new lengths of side bars, three sets of which accompany each instrument.
5. It gives the distortions beyond the elastic limit as well as inside that limit, with equal readiness, by continual revolution of the index hand.
6. Both the apparatus as a whole, and the index pointer are at all times in equilibrium, or in perfect balance.
7. The collars are cut and hinged so that they can be removed before rupture occurs.
8. The stretch is made visible to the eye of the observer at the moment of its occurrence, and the observer thus notes when this movement ceases after a given load has been put on. This is a very important matter, especially for students.

This instrument is guaranteed to do all that is here claimed. The greatest care is taken in its manufacture, and each instrument is tested by Prof. Johnson, and goes out with his certificate as to its accuracy.

Price, complete, with three sets of elastic steel armatures, circles graduated on silver, and Prof. Johnson's certificate, \$100

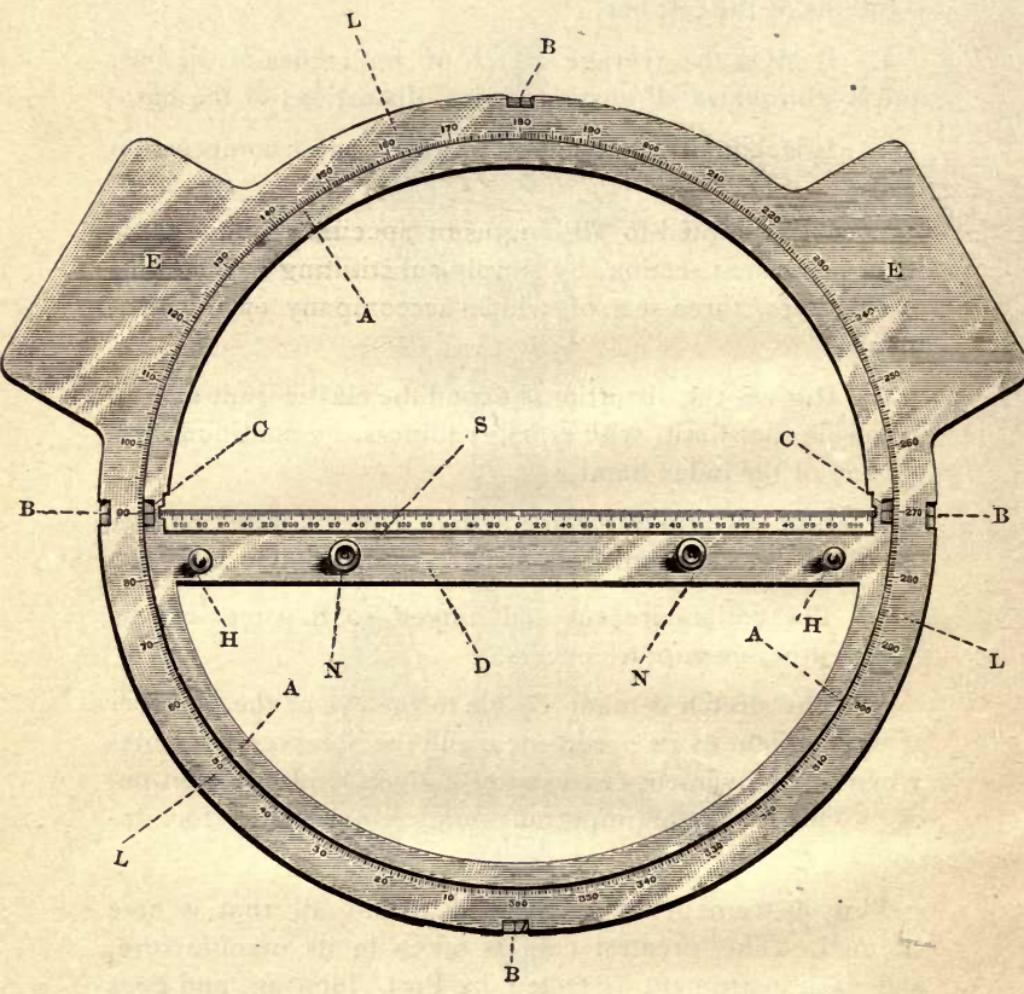


Fig. No. II.—COLBY'S TOPOGRAPHICAL PROTRACTOR.

COLBY'S TOPOGRAPHICAL PROTRACTOR.

This perfect instrument was designed by Mr. B. H. Colby, an Engineer of many years' experience upon Government surveys.

While it can be used for all kinds of ordinary protracting, it was especially designed for the plotting of angles and distances by polar co-ordinates, as taken by the ordinary method of stadia surveying. For this purpose, this protractor is without a rival, either in speed or accuracy.

It is made in three pieces. The largest piece is the limb, L, L, L, graduated from 0 to 360° , with 15-minute divisions; E, E, are projections, or ear-pieces, upon which lead weights are placed. The limb has four indices, B, B, B, B, 90° apart, by which the protractor is oriented. A, A, A, is the alidade, perfectly fitted to revolve inside the limb, easily and with no lost motion. G, G, are indexes carried by the alidade, 180° apart. To the bar D, of the alidade, is attached the scale S, by the small screws and nuts. N, N, the scale has zero mark in middle, and is graduated both ways. It can be taken off by unscrewing the nuts N, N, and a scale of different denomination substituted when desired.

A groove and small clips, upon underside, hold all the parts together. A slight space is provided for, when in use, to prevent the scale rubbing upon the paper.

Too much cannot be said of the merits of this protractor.

We make it of German Silver, of any size desired, and graduate scale as required. Each protractor is put up in handsome case.

Prices are as follows:

	Price.
12-inch limb	\$ 75 00
10 " "	55 00
9 " "	45 00
Extra scales, each	10 00

COLBY'S SLIDE RULE FOR STADIA REDUCTIONS.

GIVES DIFFERENCES OF ELEVATION BETWEEN TWO POINTS
WHEN DISTANCE-READING AND VERTICAL ANGLE
ARE KNOWN.

This adaptation of the slide rule was designed and used by Mr. B. H. Colby, engineer in charge of the extensive topographical surveys made by the City of St. Louis. It takes the place of tables or diagrams, and is much superior to either.

In practice it has been found to be about three times as rapid as the tables, and almost as accurate.

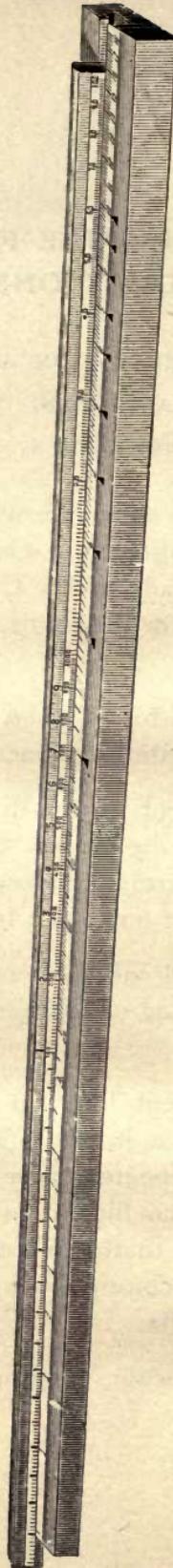
It will give 25 per cent of the differences met with in stadia work correctly to the nearest thousandth of a foot; 50 per cent to the nearest hundredth of a foot, and all differences to the nearest tenth of a foot.

It saves much mental labor of a grinding nature, and can be used by any person of ordinary intelligence after a few minutes instruction.

The scales are $4\frac{1}{2}$ feet long, mounted upon wooden frame and slide as shown in cut. The upper graduation is a logarithmic scale repeated twice, the logarithms being affected by a constant coefficient, whose value was taken so as to give correctly to the nearest tenth of a foot, all differences of elevation commonly met with in topographical surveying with stadia.

The lower, or arc scale, is graduated up to twenty degrees.

Fig. No. 12.—COLBY'S SLIDE RULE.



In using the scale, the graduation mark on the upper scale representing the distance, is brought coincident with the zero mark on the lower scale, the difference in vertical height can then be read from the upper scale at the point coincident with the required vertical angle on the lower scale.

In the *Journal of the Association of Engineering Societies* (January, 1893), Prof. J. B. Johnson, of Washington University, says: "The slide rule here described has been adopted for the use of the students in the University, and I am free to say that it furnishes the most expeditious method I have ever seen for reducing stadia observations."

Colby's Slide Rule is now being adopted upon topographical surveys throughout the country, and must soon be recognized as an indispensable adjunct to the stadia.

Price \$18.00

Besides the scientific instruments illustrated in this pamphlet, we are prepared to manufacture others of almost any description. Among these may be mentioned cathetometers, telemeters, spectrometers, etc.

The cathetometer is an instrument designed to measure with precision minute differences in height.

It consists principally of a very solid tripod case, usually made of brass, supporting a standard made of brass; the standard usually consists of two brass tubes to which is very firmly attached a dove-tailed bar with a scale fixed in the center and graduated as may be required; upon this bar slides a carriage; a small leveling instrument pro-

vided with a fine telescope and the usual cross wires is secured to this carriage, which has also a vernier scale and is balanced by lead weights suspended within the brass tubes.

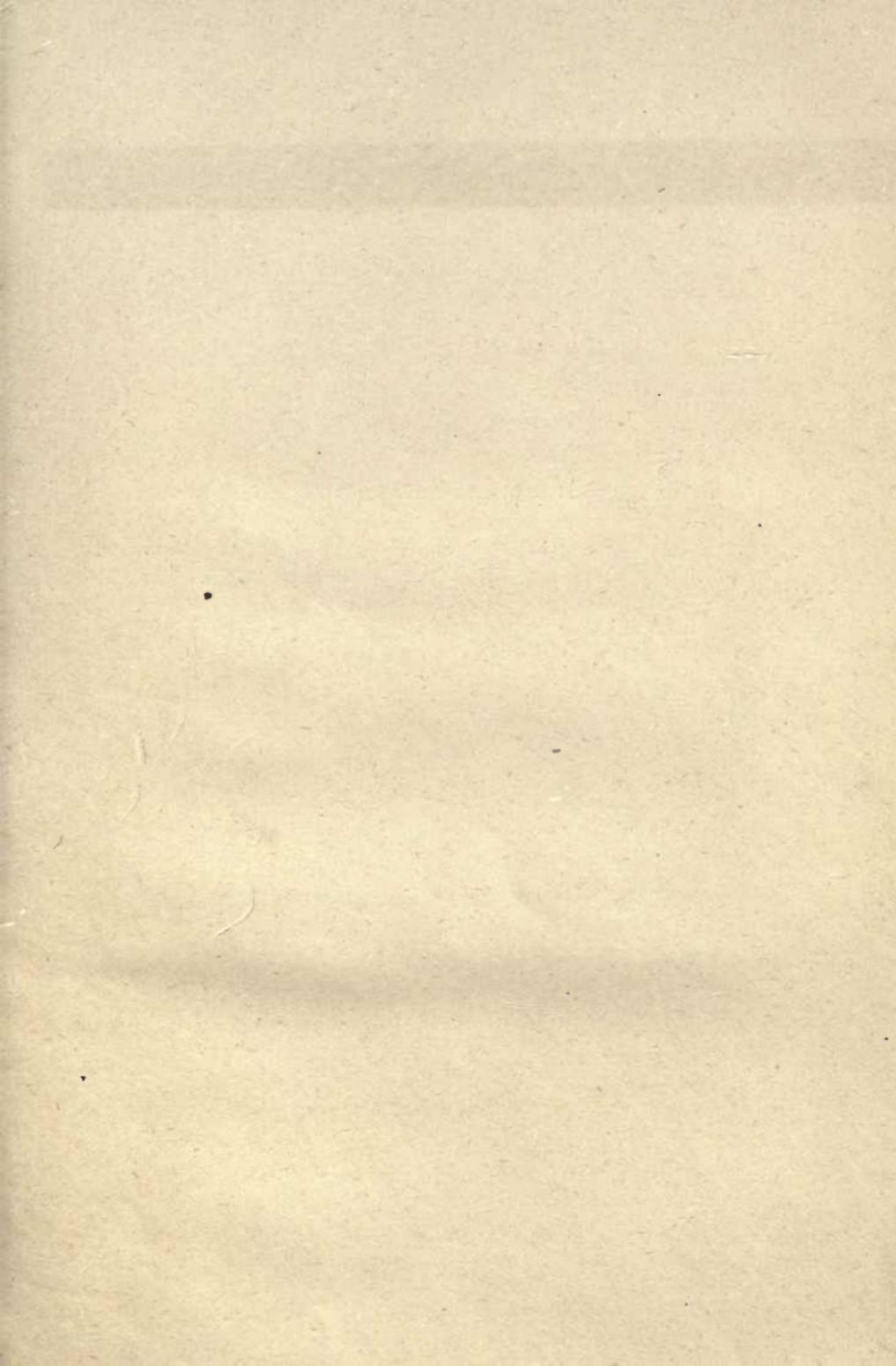
A movable clamping piece is fitted below the carriage and is fixed at any point required, by a screw. A micrometer screw passes through the center of the clamping piece; this screw has a large head, graduated into one hundred parts, and having an index at its side, affords a means of reading a very small movement of the carriage as it is carried by the screw.

The scale in front of the standard is read by the vernier fixed to the carriage.

The column has an apparatus by which it can be made perfectly plumb. This operation is effected by leveling screws in base; said base having three long arms, forming the tripod.

NOTE.—We are now making a design to simplify the above method of construction, and consequently reduce the cost of manufacture.

To those interested in the above-mentioned instruments, further description and prices will be cheerfully given when required. We will endeavor to describe them more completely, and possibly illustrate them, in future catalogues.



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